DIGITAL KNOWLEDGE EXCHANGE FOR CIRCULARITY OF MATERIALS

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DLR

Sustainability and Circular Economy

- European Green Deal (2019)
- New Circular Economy Action Plan (2020)
- Ecodesign Directive with the Ecodesign for Sustainable Products Regulation (ESPR, 2022)

- Goals:
  - Transformation to circular economy
  - Better product designs: longevity, repair-ability, recycling
  - Reduction of CO_2 footprint
  - Increased energy and resource efficiency
  - Mitigation of supply risks

Source: EU Parliament 2015

Project Aspects and Goals
Methods and Technologies for an intelligent Circularity of Materials – MaTiC-M

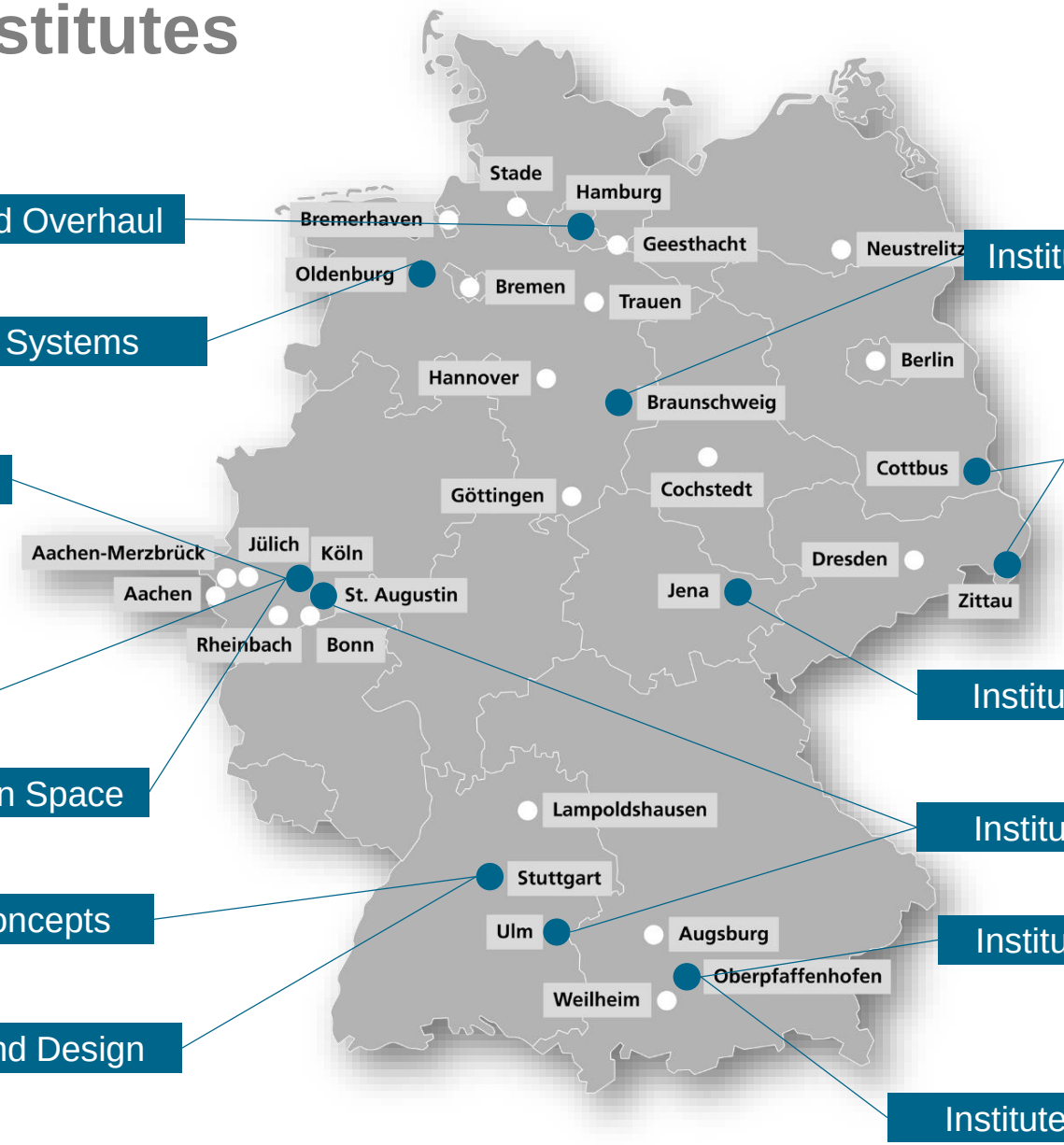
Designs for Circularity

Development of **sustainable Technologies**

- Material selection
- Material quantity
- Disassembly concepts
- Modulization
- Joining techniques
- Component tracing
- Performance- & design requirements
- Predetermined breaking points

- Increase in energy & resource efficiency
- Improvement of CO_2-Footprints
- Mitigation of supply risks
- Higher recycling rates
- Less environmental damage
- Uniform design methodology
- More transparency

Participating Institutes



Institute of Maintenance, Repair and Overhaul

Institute of Networked Energy Systems

Institute of Future Fuels

Institute of Materials Solutions

Institute of Materials Physics in Space

Institute of Vehicle Concepts

Institute of Structures and Design

Institute of Lightweight Systems

Institute of Low-Carbon Industrial Processes

Lead

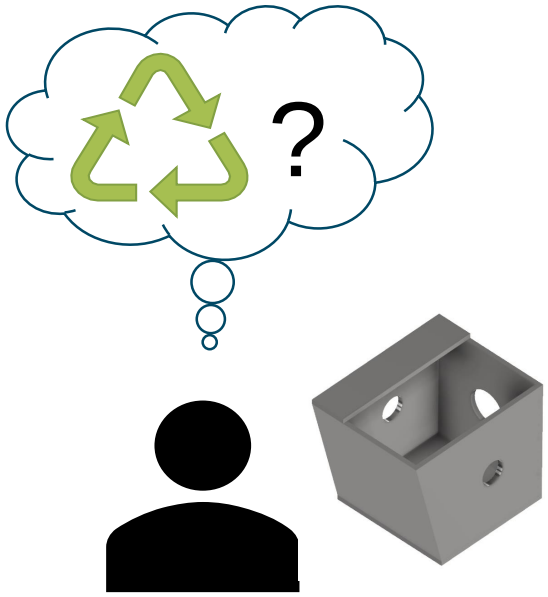
Institute of Data Science

Institute for AI Safety and Security

Institute of Robotics and Mechatronics

Institute of System Dynamics and Control

Digital Tool in MaTiC-M

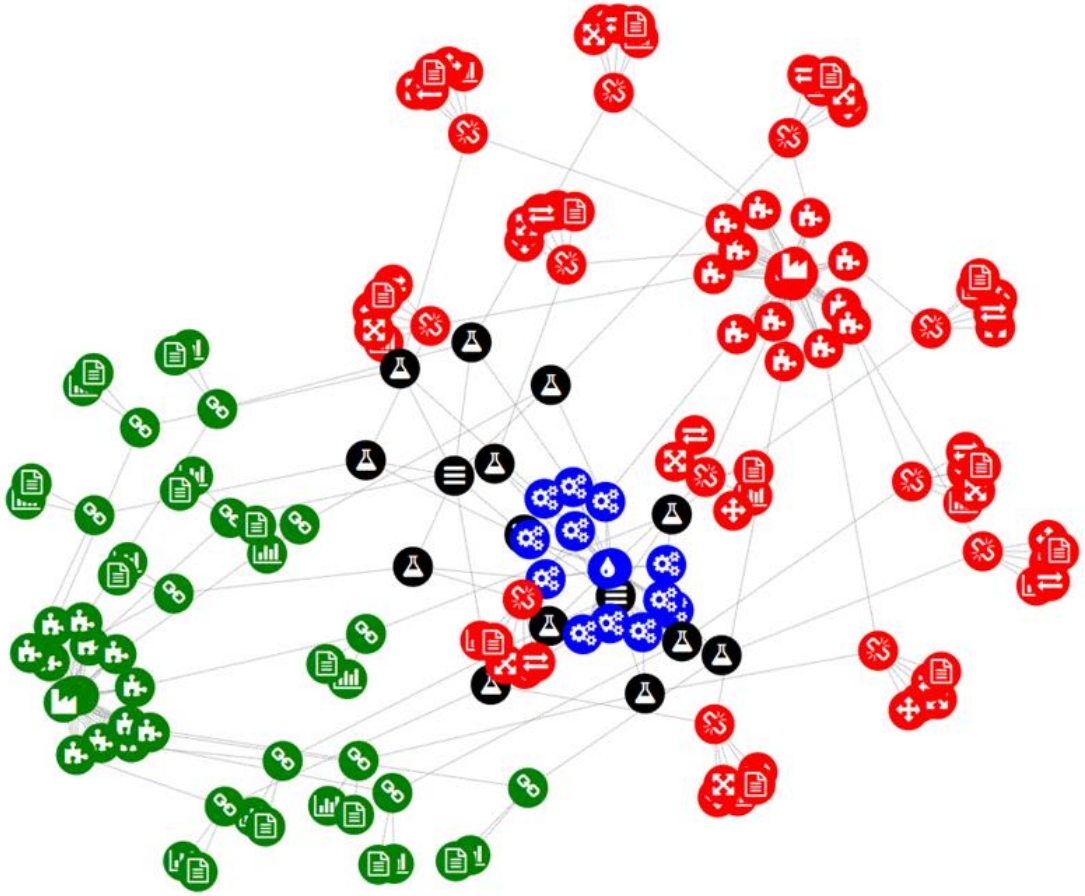


Information needed:

- Recycling routes of materials used
- Alternative materials
- Alternative assembly techniques
- Matching between assembly group and suitable recycling routes
- Properties of assembly group
  - Parts
  - Materials
  - Joining techniques

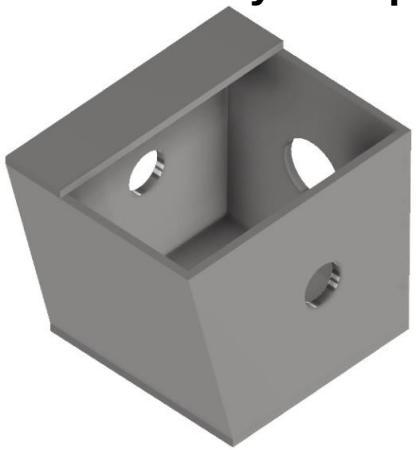
Knowledge Graphs

- Digital representation of real world
  - Objects
  - Relations
- Example:
  - Components
    - Consist of material, have geometry, …
  - Assembly techniques
    - Detachable?, parameters, …
  - Resulting components
    - Have properties like chemical or temperature resistance

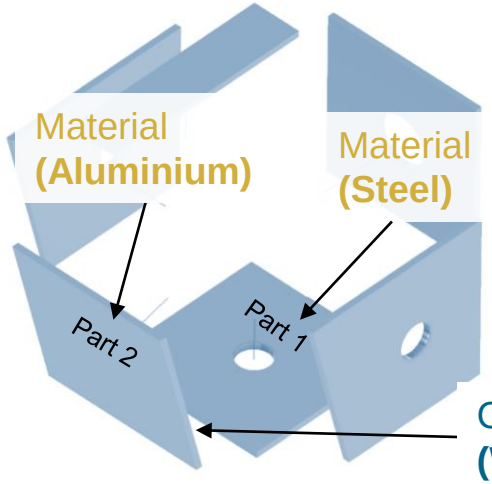


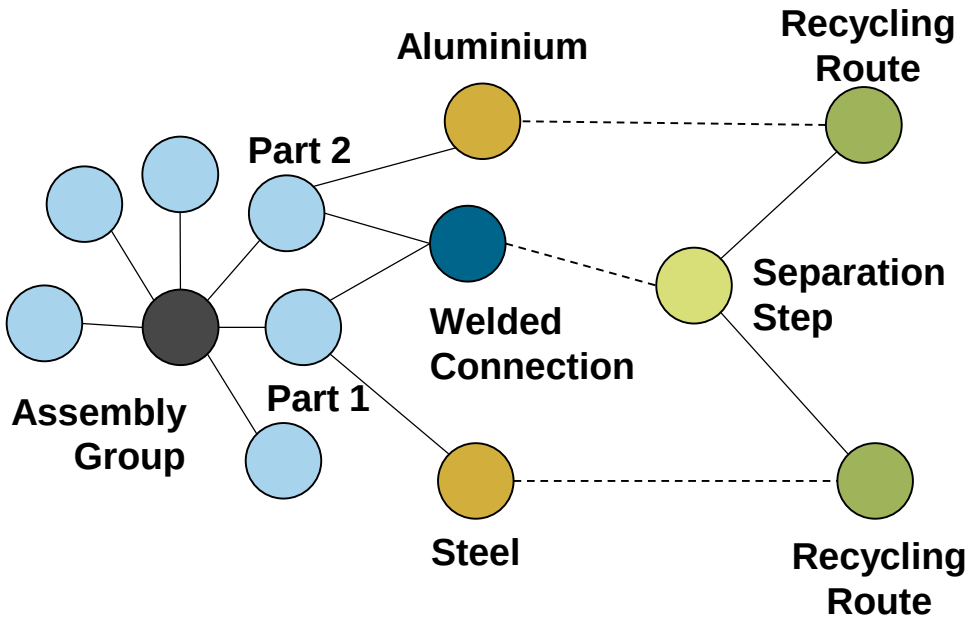
MaTiC-M Knowledge Graph and Digital Tool

Assembly Group → **Knowledge Graph** ← **Recycling**



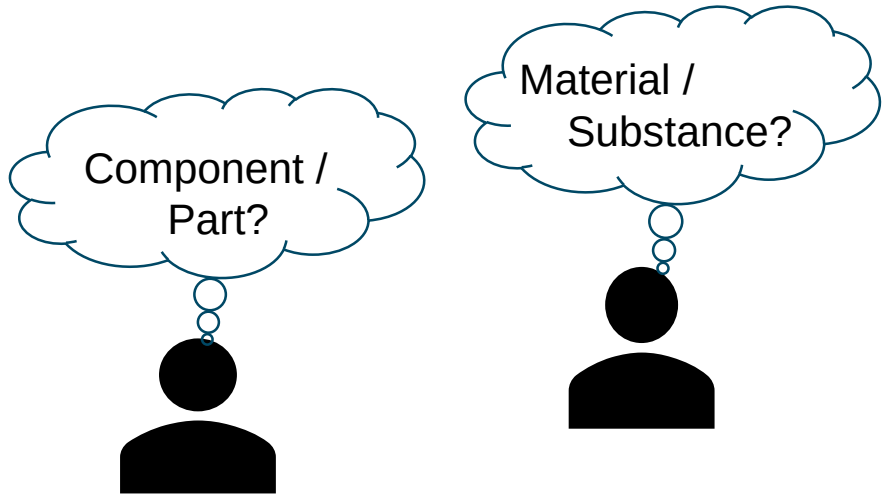
Feature Extraction





Difficulties

- Common understanding of concepts
  - Norms?
  - Different names per domain
- Quality Assurance
  - Domain experts – in a range of domains
  - But not semantic experts
- Guidance
  - Again, domain- but not semantic experts



Impressum

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